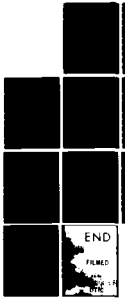
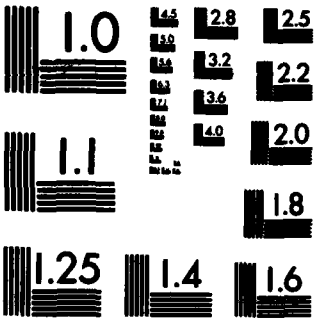
AD-A145 593 AFCS (ARMY FACILITIES COMPONENTS SYSTEM) CLIMATIC ZONE LABOR ADJUSTMENT F.. (U) CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAIGN IL R L BRAUER ET AL.

1/1

UNCLASSIFIED AUG 84 CERL-TR-P-165 IAO-E87830111 F/G 5/1 NL



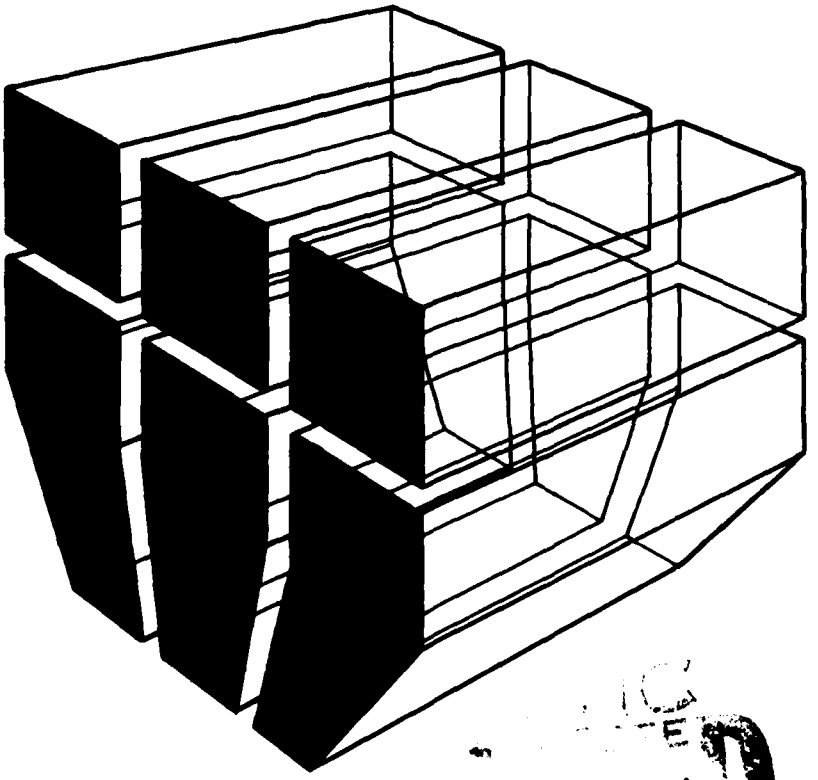


US Army Corps
of Engineers
Construction Engineering
Research Laboratory

TECHNICAL REPORT P-165
August 1984

AFCS CLIMATIC ZONE LABOR ADJUSTMENT FACTORS

by
Roger L. Brauer
Gerald J. Brown
Edward Koehn
Samuel T. Brooks
Thomas Mahon



UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER USA-CERL TR P-165	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AFCS CLIMATIC ZONE LABOR ADJUSTMENT FACTORS		5. TYPE OF REPORT & PERIOD COVERED FINAL 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Roger L. Brauer, Samuel T. Brooks Gerald J. Brown, Thomas Mahon Edward Koehn		8. CONTRACT OR GRANT NUMBER(s) IAO E87830111
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Construction Engr Research Laboratory P.O. Box 4005 Champaign, IL 61820		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE August 1984 13. NUMBER OF PAGES 38
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are available from the National Technical Information Service
Springfield, VA 22161

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Army Facilities Components System
labor
productivity
construction
climate

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Army Facilities Components System (AFCS) Climatic Zone Labor Adjustment Factors are used to estimate construction labor costs in different climatic zones for theater of operations countries. Existing AFCS factors are analyzed for validity using published field data and computer technology. A regression analysis of the information used has generated revised factors.

(Continued)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

BLOCK 20 (Cont'd)

Labor adjustment factors were also developed for using local national versus troop labor in U.S. military theater of operations (TO) construction. These factors allow the estimator to allow for conditions such as poor communication and little experience with U.S. equipment and methods.

These labor adjustment factors will be used when accessing the AFCS to estimate labor/cost for TO construction.

FOREWORD

This investigation was performed for the Facilities Development Branch, U.S. Army Engineer Division, Huntsville, AL, under Intra-Army Order (IAO), E87830111. The Technical Monitor was James Winters, HNDED-FD.

R. L. Brauer, G. J. Brown, S. T. Brooks, and T. Mahon work in the Facilities Systems Division (FS), U.S. Army Construction Engineering Research Laboratory (USA-CERL). Dr. Edward Koehn is an Associate Professor at Purdue University.

E. A. Lotz is Chief of FS. COL Paul J. Theuer is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

CONTENTS

TABLES

FIGURES

AFCS CLIMATIC ZONE LABOR
ADJUSTMENT FACTORS

1 INTRODUCTION

Background

The Army Facilities Components System (AFCS)[1] is a computerized military engineering construction support system designed in response to the need for an improved construction planning method in the theater of operations (TO). One factor which must be considered in TO construction planning is worker productivity in different climates. To allow for these differences, the U.S. Army Construction Engineering Research Laboratory (USA-CERL) in 1971 adapted a set of multipliers for use with the AFCS. The multipliers had been used for several years in construction labor estimates, probably originating from records on Army overseas experience.* The "AFCS Climatic Zone Labor Adjustment Factors" were based on an earlier mathematical model,[2] in which the old factors were scaled using a value of 1.00 for normal (temperate) conditions and assuming normal worker output. Worker efficiency factors in the model had been derived from a set of equations that measure average skin temperature as a function of air temperature, wind speed, relative humidity, solar radiation, type of task being done, and clothing worn. These results were correlated with some field data[3] on productivity to establish an expression of labor efficiency. The factors resulting from this scale-up were to be used with the corresponding four climatic zones for which the Army identifies standard conditions.[4]

Based on its mission to supply accurate engineer estimates in support of operation orders, the 416th Engineer Command asked the U.S. Army Engineer Division, Huntsville, AL, to validate the factors based on current knowledge of climatic zones and improved analytical techniques. Huntsville tasked USA-CERL with this project. Revised factors should reflect any changes since 1971 in materials, construction methods, and equipment that could affect laborer productivity. Recent information on seasonal climatic factors was to be included, and a matrix was to be developed to account for use of local national (indigenous) labor rather than U.S. engineer troops. This information would help base development planners, engineer commands or units, and Corps of Engineers estimators in developing accurate construction labor estimates.

---

[1]Technical Manual (TM) 5-304, Army Facilities Components System: User's Guide (U.S. Department of the Army, October 1979).

*However, the exact origin is unknown.

[2]E. J. Kuipers, A Method of Forecasting the Efficiency of Construction Labor in Any Climatological Conditions, Ph.D. Dissertation, University of Illinois (Ann Arbor, MI: University Microfilms International, 1976).

[3]NAVFAC P-385, Base Development Planning for Contingency Operations (U.S. Department of the Navy, Naval Civil Engineering Laboratory, July 1973).

[4]Army Regulation (AR) 70-38, Research, Development, Test, and Evaluation of Material for Extreme Climatic Conditions (U.S. Department of the Army, August 1979).

Objectives

The objectives of this study were to (1) validate and/or revise the AFCS Climatic Zone Labor Adjustment Factors using field data and new mathematical techniques and (2) develop a matrix that includes local nationals and troops in using these factors to estimate labor requirements.

Approach

State-of-the-art methods for adjusting labor factors based on climate were investigated, and field data were collected on worker productivity for various outdoor climates. This information was used in a regression analysis to develop new factors that could be compared with the existing ones.

Data were then collected on worker productivity for different local nationals under various climatic conditions, and these results were used to develop factors that would compare indigenous to troop labor. All information was compiled into matrices of extended labor adjustment factors.

Scope

This study considers only the 46 countries of primary interest to the Facilities Development Branch, U.S. Army Engineer Division, Huntsville, AL. These countries are the focus of Huntsville's Foreign Equivalent Construction Stock Items and Local Building Component Study, Phases I and II.[5]

Mode of Technology Transfer

It is recommended that the results from this study be incorporated into Army Technical Manual (TM) 5-304, AFCS User's Guide.

[5]Louis Berger International, Inc., AFCS Foreign Local Building Components and Construction Materials, Addendum "A," Central and South America, Draft Report (U.S. Army Engineer Division, Huntsville, March 1984).

2 ANALYSIS OF EXISTING FACTORS

Methods for Standardizing Atmospheric Conditions

The four AFCS Climatic Zones were established based on air temperature, wind velocity, relative humidity, and solar radiation. AR 70-38[6] gives the range of environmental factors associated with each climatic category and Figure 2-1 of TM 5-304[7] shows the geographic extent of each.

In Kuipers' model, the atmospheric data used in the equations came from international records exchange between zone countries and the U.S. Department of Commerce Environmental Sciences Services Administration. The factors were calibrated using a complex association of temperature, wind speed, and relative humidity. Measurement methods now exist that express atmospheric conditions as one value. These methods can be used to standardize different forms of reported climatological data for use in statistical analysis. (For hot climates, the technique measures heat stress; a different scale is used to measure cold stress for extremely cold regions.

Heat Stress Measurement

Four basic factors determine the degree of heat stress exerted by the environment: air temperature, humidity, air movement, and heat radiation (and/or direct conduction) from objects. Several heat stress indices have been developed to predict whether exposures to hot environments will result in excessive heat strain. The two used most are the Heat Stress Index (HSI) and the Wet-Bulb Globe Temperature (WBGT) index. Instrumentation and calculations required for a WBGT assessment are simpler than those for the HSI (Figure 1).

The WBGT index was developed as a simple method for determining if military troops are likely to suffer from heat illness in hot environments.[8] Only two or three measurements are needed: wet-bulb (static) temperature (WB), dry-bulb temperature (DB), and globe temperature (GT). To convert other forms of atmospheric data into WBGT values, one of two equations can be used, depending on the presence of a solar load:

$$WBGT = 0.7WB + 0.2GT + 0.1DB \text{ (with solar load)} \qquad [Eq\ 1]$$

$$WBGT = 0.7WB + 0.3GT \text{ (without solar load).} \qquad [Eq\ 2]$$

An average WGBT value can thus be computed if a person is exposed to a sequence of differing thermal environments.

Cold Stress Measurement

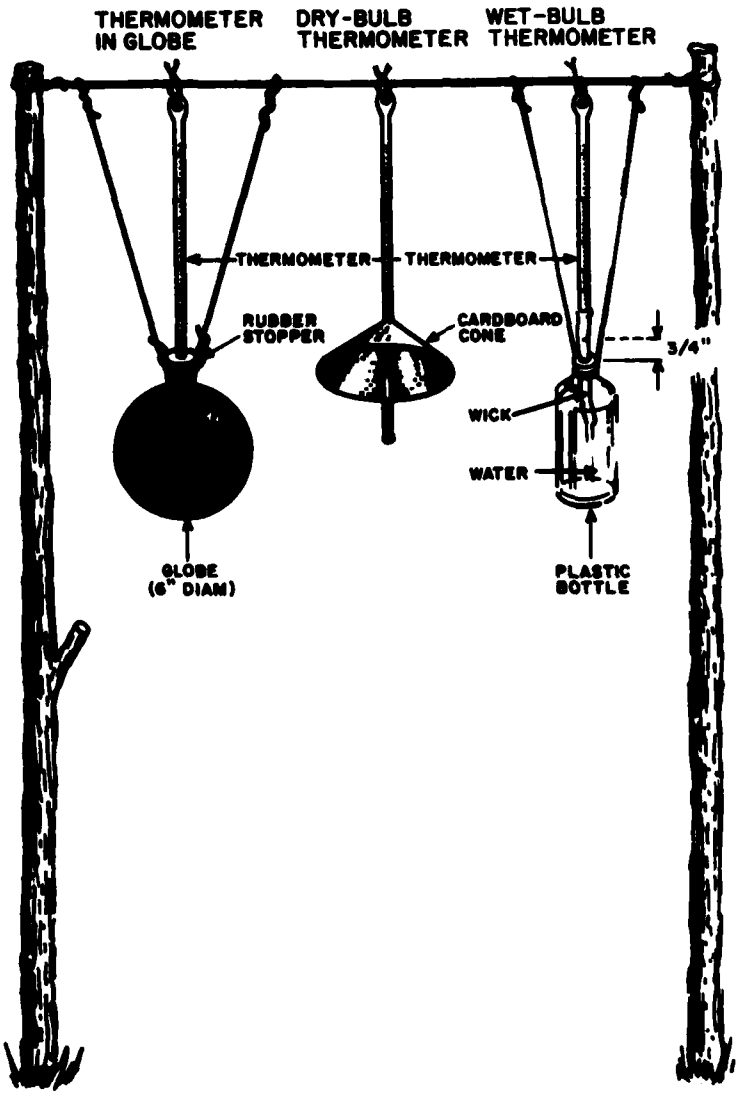
Two basic factors determine the degree of cold stress exerted by the environment: air temperature and wind velocity. High humidity at colder

---

[6] AR 70-38, Research, Development, Test, and Evaluation of Material for Extreme Climatic Conditions.

[7] TM 5-304, Army Facilities Components System: User's Guide.

[8] TB MED 507, Prevention, Treatment, and Control of Heat Injury (Headquarters, Departments of the Army, Navy and Air Force, July 1980).



WBGT = 0.7 WB + 0.2GT + 0.1DB

(WITH A SOLAR LOAD)

Figure 1. WBGT index field apparatus.

temperatures lowers productivity; however, these effects can be reduced greatly when laborers wear suitable clothing and are protected from the wind.

One of the few cold stress indices is the Windchill Index (WI) used by the military.[9] The WI was devised to assess the relative discomfort of cold in relation to the air temperature and wind speed. The basic concept recognizes that convection is the most important single avenue of heat loss in a cold environment. Table 1 gives windchill effects expressed in equivalent chill temperatures, i.e., those which cause the same rate of cooling at different wind velocities. This table was used to standardize the climatological data used in the regression analysis.

Data Collection

A literature search revealed that most studies on work environment have been done by physiologists or by firms investigating design procedures for heating and ventilating systems. In addition, work on identifying comfort zones has been largely for indoor environments. Six sources were located that contain raw data on productivity in different climates;[10] these data were used in the analysis. (Not all sources reported data for all 46 countries, and information was unavailable for five of those countries.)

USA-CERL also consulted Corps of Engineers officials, the Bureau of Labor Statistics (Foreign Labor Statistics Branch), the U.S. Department of Housing and Urban Development, and the National Constructors Association. However, very little additional data on this subject were available.

Analysis

Temperature and Humidity Versus Productivity

Matrices were developed for each of the 46 countries studied (see appendix). These matrices were based on average monthly temperature and relative humidity versus productivity predictions from the six sources. A mean was calculated for each month and this column was averaged for an annualized mean. The last column in the matrix, "Multiple," was calculated by taking the inverse of the mean, or productivity factor. Thus, an average annual multiplier can be figured for each country. Table 2 lists the average annual data from

[9] MIL-HDBK-759, Human Factors Engineering Design for Army Material (U.S. Department of Defense, March 1975).

[10] J. A. Havers, and R. M. Morgan, Optimal Construction Plans for Cold-Weather Conditions (U.S. Army Cold Regions Research and Engineering Laboratory [CRREL], June 1969); Extra for Winter Allowance (Chicago Bridge and Iron, April 23, 1968); C. T. Grimm and N. K. Wagner, "Weather Effects on Mason Productivity," Journal of the Construction Division, American Society for Civil Engineers (ASCE), (September 1974); E. Koehn and D. Meilhede, "Cold Weather Construction Costs and Accidents," Journal of the Construction Division, ASCE (December 1981); All-Weather Home Building Manual (National Association of Home Buildings [NAHB] Research Foundation, November 1975); The Effect of Temperature on Productivity (National Electrical Contractors Asocation, Inc. [NECA], 1974).

Table 1

Cooling Power of Wind Expressed as Equivalent Chill Temperature
From Field Manual (FM) 31-70, Basic Cold Weather Manual
(U.S. Department of the Army, April 1968.)

WIND SPEED		TEMPERATURE (°F)																				
KNOTS	MPH	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
CALM	CALM	EQUIVALENT CHILL TEMPERATURE																				
4	5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60	-70
9	10	30	20	15	10	5	0	-10	-15	-20	-25	-35	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95
13	15	25	15	10	0	-5	-10	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	-110
17	20	20	10	5	0	-10	-15	-25	-30	-35	-45	-50	-60	-65	-75	-80	-85	-95	-100	-110	-115	-120
22	25	15	10	0	-5	-15	-20	-30	-35	-45	-50	-60	-65	-75	-80	-90	-95	-105	-110	-120	-125	-135
26	30	10	5	0	-10	-20	-25	-30	-40	-50	-55	-65	-70	-80	-85	-95	-100	-110	-115	-125	-130	-140
30	35	10	5	-5	-10	-20	-30	-35	-40	-50	-60	-65	-75	-80	-90	-100	-105	-115	-120	-130	-135	-145
35	40	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150

WINDS ABOVE 40MPH HAVE LITTLE ADDITIONAL EFFECT	INCREASING DANGER (Flesh may freeze within 1 minute)	GREAT DANGER (Flesh may freeze within 30 secs)

Table 2

Climatic Labor Productivity Factors

NORTHERN GROUP

	MEAN	MULTIPLE
ZONE 1-UNITED KINGDOM	0.92	1.08
England	0.93	1.08
Ireland	0.92	1.09
Scotland	0.92	1.09
ZONE 2-NORTHERN EUROPE	0.91	1.10
Luxembourg	0.92	1.09
Netherlands	0.92	1.09
Belgium	0.91	1.10
Germany	0.91	1.10
Sweden	0.90	1.11
Norway	0.89	1.12
Denmark	0.91	1.10
ZONE 3-SOUTHERN EUROPE	0.92	1.09
Spain	0.92	1.09
Portugal	0.92	1.09
France	0.92	1.09
Italy	0.94	1.06
Switzerland	0.92	1.09
Austria	0.92	1.09
Turkey	0.93	1.08
Greece	0.88	1.14
ZONE 4-MIDDLE EAST	0.84	1.18
Egypt	0.84	1.19
Saudi Arabia	0.81	1.23
Oman	0.84	1.19
Kuwait	0.82	1.22
Israel	0.88	1.14
Lebanon	0.89	1.12
Pakistan	0.82	1.22
ZONE 5-FAR EAST	0.91	1.10
Korea	0.89	1.12
Japan	0.92	1.09
Taiwan	0.91	1.10

SOUTHERN GROUP

	MEAN	MULTIPLE
ZONE 1	0.89	1.12
Costa Rica	0.89	1.12
El Salvador	0.89	1.12
Guatemala	0.90	1.11
Honduras	0.89	1.12
Mexico	0.88	1.14
ZONE 2	0.83	1.20
Colombia	0.83	1.20
Ecuador	0.90	1.11
Panama	0.79	1.27
Venezuela	0.80	1.25
ZONE 3	0.90	1.11
Brazil	0.87	1.15
Bolivia	0.90	1.11
Chile	0.90	1.11
Paraguay	0.91	1.10
Peru	0.91	1.10
Uruguay	0.92	1.09
ZONE 4	0.88	1.14
Dominican Repub	0.87	1.15
Haiti	0.91	1.10
Jamaica	0.86	1.16

the appendix according to theater of operations zone for northern and southern groups.

As an example of how these multipliers might be used, consider a project that, in a temperate zone (1.00) and with normal worker efficiency, takes an estimated 1000 manhours to complete. If the same project were to be done in a southern group zone 1 country, the 1000 manhours would be multiplied by 1.12 (Table 2) for a new estimate of 1120 manhours.

Regression Curve

Figure 2 was developed from a regression analysis of data in the appendix. The values for average temperature and relative humidity were adjusted using the methods described above, with WBGT used for high temperatures and WI used for low ones. To define frigid, temperate, desert, and tropical zones, values of -25°F, 60°F, 90°F, and 100°F, respectively, were assigned. Thus, WI was used to adjust to frigid; WBGT was used for the other three values. The regression curve in Figure 2 is the best fit using the Statistical Package for Social Sciences (SPSS) computer program.

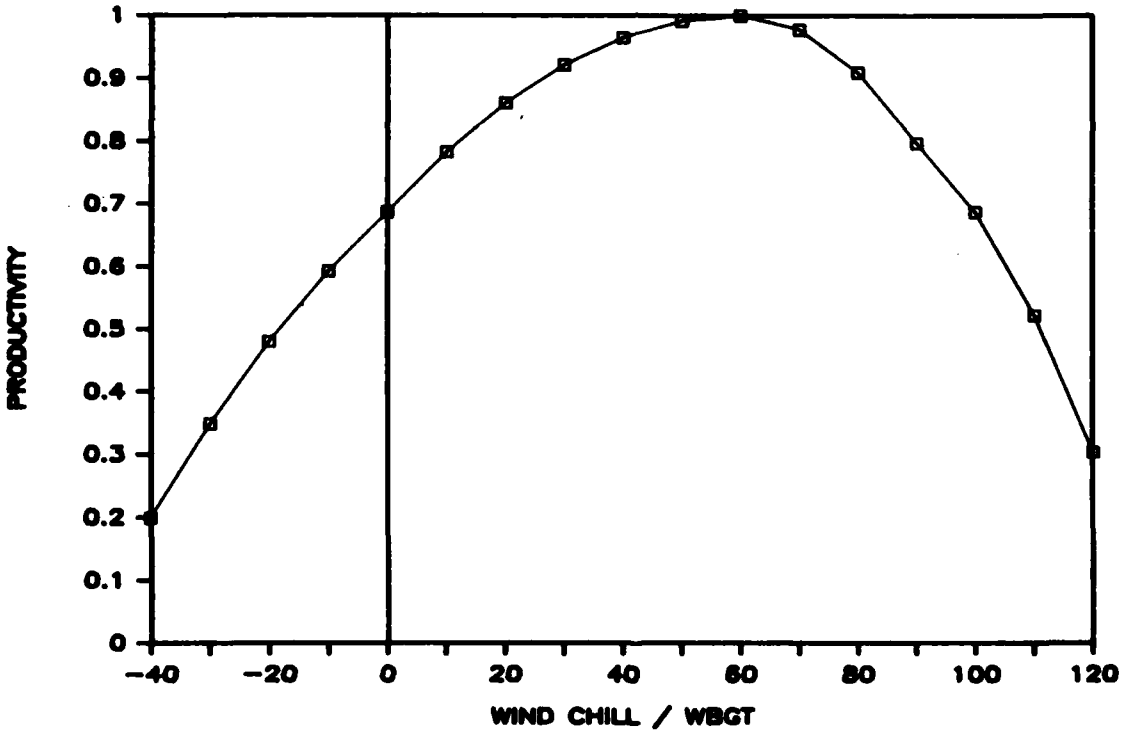


Figure 2. Regression analysis of temperature versus productivity.

The new Climatic Zone Labor Adjustment Factors were derived by locating the temperature coordinates corresponding to each zone and reading the productivity value. The multiplier was obtained by taking the inverse of this value. Table 3 compares the results of this analysis with the existing factors.

Table 3

AFCS Climatic Zone Labor Adjustment Factors

Zone	Multipliers	
	Existing	Revised
Temperate (60°F)	1.00	1.00
Tropical (100°F)	1.45	1.45
Desert (90°F)	1.15	1.25
Frigid (-25°F)	2.57	2.41

Discussion

The factors developed in this study are very similar to those used previously in the AFCS, with desert and frigid zones differing by .10 and .16, respectively. The lack of raw data limits this study's statistical validity. However, these new factors represent the best method now available for adjusting labor estimates according to climate. As better records are compiled on atmospheric conditions and worker efficiency, it will become possible to refine construction estimation techniques in TO countries.

3 OTHER AFCS ADJUSTMENT FACTORS

For the second part of this work, Huntsville Division had asked USA-CERL to compare productivity for U.S. troop construction labor versus local national labor. During the study, two subtasks were also requested: (1) to form an annual construction factor matrix for labor and materials and (2) to compare troop versus contract labor.

Indigenous Labor Adjustment Factors

The purpose of comparing U.S. troop productivity with local nationals' was to account for unavoidable worksite conditions that reduce labor efficiency. Examples of conditions that may hinder the local laborer's productivity are:

- Language barrier
- Unfamiliar equipment and methods
- Limited skill in reading blueprints
- Suboptimal physical condition.

Data Collection and Analysis

A literature search and queries to some firms involved with overseas construction produced several data sources comparing U.S. construction labor with indigenous labor.[11] Most information came from the companies with construction experience outside the continental United States (OCONUS). In addition, an estimator at the USACE Mediterranean Division-Rear was contacted to determine how Army productivity factors were derived for construction in the Middle East (Saudi Arabia, Egypt, and Oman). It was learned these factors are developed by doing annual surveys; this information is included in the Army's Unit Price Book, part of the Computer-Aided Cost Estimating System (CACES).[12]

In this analysis, the fully acclimated, physically fit U.S. military labor was assigned a value of 1.00. Table 4 shows the data reported from each source, with means shown in the last column for each country. Again, taking

[11] Worldwide Cost Multipliers (Marshal and Swift Publishing Co., November 1982); Housing and Building Technology in Developing Countries, MSU International Business and Economic Studies (Michigan State University - East Lansing, 1966); Detail Cost Manual (Cost Systems Engineers, Inc., 1981-82); Anonymous Firm, Response to request for data (July 1983); Delphcon Builders, Inc., ltr dated 22 July 1983; Kemper Group, International Cost Indices, ltr dated 20 July 1983.

[12] Engineering Pamphlet (EP) 415-345-5, Computer-Aided Cost Estimating System (CACES) (U.S. Army Corps of Engineers, March 1983).

Table 4

Labor Productivity by Country

LABOR ADJUSTMENT RATES

NORTHERN GROUP	S	MSU	RR	FIRM	EL-L	EL-H	K	AFCS-L	AFCS-H	R	ACE PL	ACE PH	VIS	AN	AL	CE-L	CE-H	T	SGA	MEAN
ZONE 1-UNITED KINGDOM																				0.66
England	0.66	0.66	0.68	0.52			0.67				0.80	0.90	0.68			0.65				0.67
Ireland	0.66		0.57	0.62									0.68			0.65				0.63
Scotland		0.66		0.69			0.67									0.65				0.61
ZONE 2-NORTHERN EUROPE																				0.86
Luxembourg													0.95							0.95
Netherlands		1.00		0.88			0.67						0.86			0.63				0.81
Belgium			0.66	0.88			0.83						0.96			0.67	0.77			0.80
Germany	0.89	0.91	0.81	0.99			0.71				1.00	1.10	0.96			0.75	1.00			0.91
Sweden		0.91		0.83												0.88				0.87
Norway		0.82		0.85												0.81				0.83
Denmark		0.91		0.83									0.97			0.78				0.87
ZONE 3-SOUTHERN EUROPE																				0.65
Spain	0.56			0.69									0.67			0.56				0.56
Portugal	0.67															0.53				0.60
France	0.65	0.66	0.68	0.83									0.91			0.75				0.76
Italy	0.53			0.88			0.77						0.79			0.69	0.91			0.73
Switzerland													0.95							0.95
Austria													0.74			0.68	0.66	0.67		0.63
Turkey	0.61						0.65									0.63				0.63
Greece	0.76		0.63	0.78	0.67	1.00														0.75
ZONE 4-MIDDLE EAST																				0.58
Egypt	0.68							0.58	0.68	0.88	0.20	0.30		0.77	0.39					0.68
Saudi Arabia		0.58			0.22	0.67	0.55	0.26	0.79	0.76	0.57	0.68	0.58							0.53
Oman					0.22	0.67		0.58	0.68	0.76										0.55
Kuwait		0.58			0.22	0.67		0.58	0.68	0.76	0.58									0.56
Israel	0.63		0.61					1.00	1.20											0.81
Lebanon		0.75						0.68	0.88		0.90	1.00								0.81
Pakistan		0.65		0.36	0.22			0.58	0.68	0.58	0.30	0.68	0.14						0.26	0.37
ZONE 5-FAR EAST																				0.67
Korea	0.63				0.67	1.00		0.88	0.84	1.00			0.68							0.79
Japan	0.86		0.68	0.99			0.68						0.72			0.58	1.00			0.78
Taiwan	0.59						0.53									0.14	0.58			0.66

Table 4 (cont'd)

LABOR ADJUSTMENT RATES

SOUTHERN GROUP	S	MSU	RR	FIRM	EL-L	EL-M	K	AFCS-L	AFCS-M	R	ACE	PL	PH	VIS	AH	AL	CE-L	CE-M	T	BGA	MEAN
ZONE 1																					0.50
Costa Rica		0.50			0.33	0.67													0.60		0.50
El Salvador		0.50		0.53	0.33	0.67													0.40		0.48
Guatemala	0.47	0.50			0.33	0.67													0.40		0.47
Honduras		0.50			0.33	0.67													0.40		0.48
Mexico	0.30	0.50			0.33	0.67								0.64			0.33	0.45	0.70	0.51	0.51
ZONE 2																					0.53
Colombia	0.48	0.50		0.57	0.33	0.67				0.44				0.56						0.45	0.50
Ecuador		0.50			0.33	0.67															0.50
Panama		0.50			0.33	0.67													0.70		0.55
Venezuela		0.55		0.56	0.33	0.67											0.61				0.59
ZONE 3																					0.50
Brazil	0.37	0.36		0.53	0.33	0.67								0.55			0.33	0.01		0.27	0.43
Bolivia	0.42	0.50			0.33	0.67															0.48
Chile	0.42	0.50			0.33	0.67											0.56		0.60		0.54
Paraguay		0.50			0.33	0.67															0.50
Peru	0.46	0.50			0.33	0.67														0.50	0.48
Uruguay		0.50			0.33	0.67								0.58					0.60		0.50
ZONE 4																					0.49
Dominican Republic		0.50			0.33	0.67															0.50
Haiti		0.50			0.33	0.67											0.34				0.47
Jamaica		0.50		0.48	0.33	0.67								0.44							0.51

the inverse of these productivity means, a multiplier can be calculated (Table 5). These indigenous labor adjustment factors should be multiplied by the corresponding climatic factor (Table 2) when estimating indigenous labor requirements for a particular country.

Annual Construction Factor

USA-CERL was to develop a matrix of annual construction cost factors that include both labor and materials. This information was to come from AR 415-17,[13] which covers only 15 of the 46 countries in this study.

As an example of work done in this area, USA-CERL consulted a USACE draft report for adjustment factors in the Continental United States (CONUS).[14] This study assumes productivity rates are constant throughout the country, and the total index is based on an assumed 45 percent labor/55 percent materials.

In the international sphere, however, labor productivity is not a constant value as discussed in Chapter 2. Also, the 45/55 labor-to-material ratio may not apply. Therefore, it was concluded that the current factors in AR 415-17 are still the best for estimating this parameter (Table 6).

Troop Versus Contract Labor

To determine the efficiency of troop versus contract labor, USA-CERL contacted the U.S. Army Engineer School in Fort Belvoir, VA. This agency has proponency for FMs and TMs that guide Army construction contracting. The information obtained showed that standard estimating methods such as Dodge and Means[15] are used to estimate troop labor. No multiplier exists to distinguish between troops and contractors, and was determined to be beyond the scope of this study.

---

[13] AR 415-17, Cost Estimating for Military Programming (U.S. Department of the Army, February 1980).

[14] Hanscomb Associates Inc., CONUS Location Adjustment Factor Analysis Report DACA-87-C-0040, Task 3, Vol 1 (U.S. Army Engineer Division, Huntsville, 1983).

[15] L. Dallania, Estimating General Construction Costs (F. W. Dodge Corporation, 1957).

Table 5

Labor Productivity by Country, Grouped by Zone

LABOR ADJUSTMENT RATES

NORTHERN GROUP	MEAN	MULTIPLE
ZONE 1-UNITED KINGDOM	0.64	1.57
England	0.67	1.50
Ireland	0.63	1.60
Scotland	0.61	1.63
ZONE 2-NORTHERN EUROPE	0.86	1.16
Luxembourg	0.95	1.05
Netherlands	0.81	1.24
Belgium	0.80	1.26
Germany	0.91	1.10
Sweden	0.87	1.15
Norway	0.83	1.21
Denmark	0.87	1.15
ZONE 3-SOUTHERN EUROPE	0.65	1.54
Spain	0.56	1.79
Portugal	0.40	2.50
France	0.74	1.35
Italy	0.73	1.38
Switzerland	0.95	1.05
Austria	0.63	1.58
Turkey	0.43	2.33
Greece	0.75	1.34
ZONE 4-MIDDLE EAST	0.58	1.71
Egypt	0.48	2.09
Saudi Arabia	0.93	1.08
Oman	0.55	1.82
Kuwait	0.54	1.87
Israel	0.81	1.24
Lebanon	0.81	1.23
Pakistan	0.37	2.70
ZONE 5-FAR EAST	0.67	1.49
Korea	0.79	1.26
Japan	0.78	1.29
Taiwan	0.44	2.27

SOUTHERN GROUP	MEAN	MULTIPLE
ZONE 1	0.50	1.98
Costa Rica	0.58	1.74
El Salvador	0.48	2.07
Guatemala	0.47	2.11
Honduras	0.48	2.11
Mexico	0.51	1.95
ZONE 2	0.53	1.87
Colombia	0.50	1.99
Ecuador	0.50	2.00
Panama	0.55	1.82
Venezuela	0.59	1.71
ZONE 3	0.50	1.99
Brazil	0.43	2.31
Bolivia	0.48	2.08
Chile	0.54	1.86
Paraguay	0.50	2.00
Peru	0.48	2.08
Uruguay	0.58	1.74
ZONE 4	0.49	2.04
Dominican Republic	0.50	2.00
Haiti	0.47	2.15
Jamaica	0.51	1.97

Table 6

Summary of Labor/Cost Factors

NORTHERN GROUP	TROOP CLIMATIC PRODUCTIVITY MULTIPLE	INDIGENOUS LABOR PRODUCTIVITY MULTIPLE	LOCATION ADJUSTMENT FACTOR (AR 415-17)
ZONE 1-UNITED KINGDOM	1.06	1.57	1.45
England	1.06	1.50	
Ireland	1.09	1.60	
Scotland	1.09	1.63	
ZONE 2-NORTHERN EUROPE	1.10	1.16	
Luxembourg	1.09	1.05	
Netherlands	1.09	1.24	1.40
Belgium	1.10	1.26	1.50
Germany	1.10	1.10	1.30
Sweden	1.11	1.15	
Norway	1.12	1.21	
Denmark	1.10	1.15	
ZONE 3-SOUTHERN EUROPE	1.09	1.54	
Spain	1.09	1.79	1.30
Portugal	1.09	2.50	
France	1.09	1.35	
Italy	1.06	1.30	1.10
Switzerland	1.09	1.05	
Austria	1.09	1.50	
Turkey	1.08	2.33	1.60
Greece	1.14	1.34	1.40
ZONE 4-MIDDLE EAST	1.16	1.71	
Egypt	1.19	2.09	2.50
Saudi Arabia	1.23	1.88	2.00
Oman	1.19	1.82	
Kuwait	1.22	1.87	
Israel	1.14	1.24	1.10
Lebanon	1.12	1.23	
Pakistan	1.22	2.70	
ZONE 5-FAR EAST	1.10	1.49	
Korea	1.12	1.26	1.05
Japan	1.09	1.29	1.70
Taiwan	1.10	1.37	0.60

SOUTHERN GROUP	TROOP CLIMATIC PRODUCTIVITY MULTIPLE	INDIGENOUS LABOR PRODUCTIVITY MULTIPLE	LOCATION ADJUSTMENT FACTOR (AR 415-17)
ZONE 1	1.12	1.98	
Costa Rica	1.12	1.74	
El Salvador	1.12	2.07	
Guatemala	1.11	2.11	
Honduras	1.12	2.11	
Mexico	1.14	1.95	
ZONE 2	1.20	1.87	
Colombia	1.20	1.99	
Ecuador	1.11	2.80	
Panama	1.27	1.82	1.30
Venezuela	1.25	1.71	
ZONE 3	1.11	1.99	
Brazil	1.15	2.31	
Bolivia	1.11	2.88	
Chile	1.11	1.84	
Paraguay	1.10	2.00	
Peru	1.10	2.88	
Uruguay	1.09	1.74	
ZONE 4	1.14	2.04	
Dominican Repub	1.15	2.00	
Haiti	1.10	2.15	
Jamaica	1.14	1.97	

4 CONCLUSIONS AND RECOMMENDATIONS

Published field data and computer technology have been used to revise the four AFCS Climatic Zone Labor Adjustment Factors. The updated version is temperate--1.00, tropical--1.45, desert--1.25, and frigid--2.41. In addition, adjustment factors have been developed for using local national labor versus troop labor in OCONUS construction projects. Multipliers have been given for each of the 46 countries of primary interest to USACE Huntsville Division.

It is recommended that these factors be used as multipliers when accessing the AFCS database to prepare labor and cost estimates. Although this system is not exact, it represents the best available technology for making adjustments due to climate and indigenous labor efficiency.

REFERENCES

Army Regulation (AR) 415-17, Cost Estimating for Military Programming (U.S. Department of the Army, February 1980).

AR 70-38, Research, Development, Test and Evaluation of Material for Extreme Climatic Conditions (U.S. Department of the Army, August 1979).

All-Weather Home Building Manual (National Association of Home Builders [NAHB] Research Foundation, November 1975).

Anonymous Firm, response to request for data (July 1983).

Dallania, L., Estimating General Construction Costs (F. W. Dodge Corporation, 1957).

Delphcon Builders, Inc., ltr dated 22 July 1983.

Detail Cost Manual (Cost Systems Engineers, Inc., 1981-82).

Engineering Pamphlet (EP) 415-345-5, Computer-Aided Cost Estimating System (CACES) (U.S. Army Corps of Engineers, March 1983).

Extra for Winter Allowance (Chicago Bridge and Iron, April 23, 1968).

Field Manual (FM) 31-70, Basic Cold Weather Manual (U.S. Department of the Army, April 1968).

Grimm, C. T. and N. K. Wagner, "Weather Effects on Mason Productivity," Journal of the Construction Division, American Society for Civil Engineers (ASCE) (September 1974).

Hanscomb Associates, Inc., CONUS Location Adjustment Factor Analysis Report, DACA-87-C-0040, Task 3, Vol 1 (U.S. Army Engineer Division, Huntsville, 1983).

Havers, J. A., and R. M. Morgan, Optimal Construction Plans for Cold-Weather Conditions (U.S. Army Cold Regions Research and Engineering Laboratory [CRREL], June 1969).

Housing and Building Technology in Developing Countries, MSU International Business and Economic Studies (Michigan State University-East Lansing, 1966).

Kemper Group, International Cost Indices, ltr dated 20 July 1983.

Koehn, E., and D. Meilhede, "Cold Weather Construction Costs and Accidents," Journal of the Construction Division, ASCE (December 1981).

Kuipers, E. J., A Method of Forecasting the Efficiency of Construction Labor in any Climatological Conditions, Ph.D. Dissertation, University of Illinois (Ann Arbor, MI: University Microfilms International, 1976).

Louis Berger International, Inc., AFCS Foreign Local Building Components and Construcrion Materials, Addendum "A", Central and South America, Draft Report (U.S. Army Engineer Division, Huntsville, March 1984).

Military Handbook (MIL-HDBK)-759, Human Factors Engineering Design for Army Material (U.S. Department of Defense, March 1975).

NAVFAC P-385, Base Development Planning for Contingency Operations (U.S. Department of the Navy, Naval Civil Engineering Command, July 1973).

Technical Bulletin Medical (TB MED) 507, Prevention, Treatment, and Control of Heat Injury (Headquarters, Departments of the Army, Navy, and Air Force, July 1980).

Technical Manual (TM) 5-304, Army Facilities Components System: User's Guide (U.S. Department of the Army, October 1979).

The Effect of Temperature on Productivity (National Electrical Contractors Association, Inc. [NECA], 1974).

Worldwide Cost Multipliers (Marshal and Swift Publishing Co., November 1982).

APPENDIX:

MONTHLY PRODUCTIVITY BY COUNTRY BASED ON TEMPERATURE AND HUMIDITY

COUNTRY: ENGLAND

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	39.50	80.00	0.98	0.93	0.59	0.92		0.98	0.88	1.14
February	40.00	72.00	0.98	0.93	0.61	1.00		0.99	0.90	1.11
March	44.00	63.00	0.99	0.96	0.63	1.00		1.00	0.92	1.09
April	48.00	58.00	0.99	1.00	0.65	1.00		1.00	0.93	1.08
May	54.00	57.00	0.98	1.00	0.69	1.00		1.00	0.93	1.07
June	60.00	57.00	0.97	1.00	0.75	1.00		1.00	0.94	1.06
July	64.00	55.00	0.96	1.00	0.79	1.00		1.00	0.95	1.05
August	63.00	58.00	0.96	1.00	0.78	1.00		1.00	0.95	1.05
September	59.00	63.00	0.97	1.00	0.74	1.00		1.00	0.94	1.06
October	51.00	70.00	0.99	1.00	0.68	1.00		1.00	0.93	1.07
November	44.00	77.00	0.99	1.00	0.62	1.00		0.99	0.92	1.09
December	40.50	81.00	0.98	1.00	0.61	1.00		0.98	0.91	1.09
MEAN	50.58	66.00	0.98	0.99	0.68	0.99	ERR	1.00	0.93	1.08

COUNTRY: IRELAND

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	41.00	88.00	0.98	0.93	0.68	1.00		0.96	0.89	1.12
February	41.00	86.00	0.98	0.93	0.68	1.00		0.96	0.89	1.12
March	43.50	83.00	0.98	0.96	0.61	1.00		0.99	0.91	1.10
April	46.00	78.00	0.99	1.00	0.64	1.00		0.99	0.92	1.08
May	50.50	76.00	1.00	1.00	0.67	1.00		1.00	0.93	1.07
June	54.50	75.00	0.98	1.00	0.70	1.00		1.00	0.94	1.07
July	59.00	78.00	0.97	1.00	0.73	1.00		1.00	0.94	1.07
August	59.00	81.00	0.97	1.00	0.71	1.00		1.00	0.94	1.07
September	55.00	84.00	0.98	1.00	0.68	1.00		1.00	0.93	1.07
October	50.00	84.00	1.00	1.00	0.65	1.00		1.00	0.93	1.08
November	44.50	85.00	0.98	1.00	0.64	1.00		0.99	0.92	1.08
December	41.50	88.00	0.98	1.00	0.61	1.00		0.98	0.91	1.09
MEAN	48.96	82.58	0.98	0.99	0.65	1.00		0.99	0.92	1.09

*Sources: CRREL = Havers, A., and R. M. Morgan, Optimal Construction Plans for Cold-Weather Conditions (U.S. Army Cold Regions Research and Engineering Laboratory [CRREL], June 1969); Chicago Br. and Iron = Extra for Winter Allowance (Chicago Bridge and Iron, April 23, 1968); ASCE/1 = Grimm, C. T. and N. K. Wagner, "Weather Effects on Mason Productivity," Journal of the Construction Division, American Society for Civil Engineers (ASCE) (September 1974); ASCE/2 = Koehn, E. and D. Meilhede, "Cold Weather Construction Costs and Accidents," Journal of the Construction Division, ASCE (December 1981); NAHB = All-Weather Home Building Manual (National Association of Home Builders [NAHB] Research Foundation, November 1975); NECA = The Effect of Temperature on Productivity (National Electrical Contractors Association, Inc. [NECA], 1974).

COUNTRY: SCOTLAND

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	39.00	84.00	0.97	0.93	0.60	0.92		0.97	0.88	1.14
February	39.00	83.00	0.97	0.93	0.60	0.92		0.97	0.88	1.14
March	41.50	81.00	0.98	0.96	0.61	1.00		0.98	0.91	1.10
April	44.50	76.00	0.98	1.00	0.63	1.00		0.99	0.92	1.09
May	49.00	76.00	0.99	1.00	0.67	1.00		1.00	0.93	1.07
June	55.00	73.00	0.98	1.00	0.70	1.00		1.00	0.94	1.07
July	58.50	77.00	0.97	1.00	0.72	1.00		1.00	0.94	1.07
August	58.00	79.00	0.97	1.00	0.71	1.00		1.00	0.94	1.07
September	54.00	80.00	0.98	1.00	0.67	1.00		1.00	0.93	1.08
October	48.50	81.00	0.99	1.00	0.65	1.00		0.99	0.93	1.08
November	43.00	83.00	0.98	1.00	0.63	1.00		0.99	0.92	1.09
December	40.00	84.00	0.98	1.00	0.59	1.00		0.98	0.91	1.10
MEAN	47.50	79.75	0.98	0.99	0.65	0.99		0.99	0.92	1.09

COUNTRY: LUXEMBOURG

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	32.50	84.00	0.97	0.93	0.55	0.92		0.93	0.86	1.14
February	35.00	74.00	0.97	0.93	0.58	0.92		0.96	0.87	1.15
March	41.00	62.00	0.98	0.96	0.61	1.00		1.00	0.91	1.10
April	49.00	57.00	1.00	1.00	0.67	1.00		1.00	0.93	1.07
May	55.50	60.00	0.98	1.00	0.72	1.00		1.00	0.94	1.06
June	61.50	61.00	0.96	1.00	0.76	1.00		1.00	0.94	1.06
July	64.50	59.00	0.95	1.00	0.79	1.00		1.00	0.95	1.05
August	64.00	60.00	0.95	1.00	0.80	1.00		1.00	0.95	1.05
September	57.50	69.00	0.97	1.00	0.75	1.00		1.00	0.94	1.06
October	49.50	75.00	1.00	1.00	0.67	1.00		0.99	0.93	1.07
November	41.00	86.00	0.98	1.00	0.60	1.00		0.96	0.91	1.10
December	35.50	91.00	0.97	1.00	0.57	0.92		0.94	0.88	1.14
MEAN	48.08	70.17	0.97	0.99	0.67	0.98		0.98	0.92	1.09

COUNTRY: THE NETHERLANDS

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	37.00	84.00	0.97	0.93	0.58	0.92		0.97	0.87	1.14
February	37.50	79.00	0.97	0.93	0.58	0.92		0.97	0.87	1.14
March	41.50	71.00	0.98	0.96	0.61	1.00		0.99	0.91	1.10
April	47.50	66.00	0.98	1.00	0.65	1.00		0.99	0.92	1.08
May	55.00	63.00	0.98	1.00	0.71	1.00		1.00	0.94	1.07
June	60.00	63.00	0.97	1.00	0.74	1.00		1.00	0.94	1.06
July	64.00	65.00	0.96	1.00	0.77	1.00		1.00	0.95	1.06
August	63.50	66.00	0.97	1.00	0.77	1.00		1.00	0.95	1.05
September	60.00	69.00	0.97	1.00	0.74	1.00		1.00	0.94	1.06
October	52.00	75.00	0.97	1.00	0.68	1.00		1.00	0.93	1.08
November	44.00	82.00	0.97	1.00	0.63	1.00		0.99	0.92	1.09
December	38.00	86.00	0.97	1.00	0.58	0.92		0.96	0.89	1.13
MEAN	50.00	72.42	0.97	0.99	0.67	0.98		0.99	0.92	1.09

COUNTRY: GERMANY

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	MANB	MECA	MEAN	MULTIPLE
January	38.00	79.00	0.95	0.86	0.58	0.83		0.94	0.84	1.20
February	31.00	69.00	0.96	0.88	0.58	0.92		0.97	0.86	1.16
March	45.50	68.00	0.99	0.93	0.66	1.00		1.00	0.91	1.10
April	38.00	55.00	0.97	1.00	0.89	1.00		0.99	0.91	1.10
May	54.00	56.00	0.98	1.00	0.70	1.00		1.00	0.94	1.07
June	60.00	55.00	0.97	1.00	0.75	1.00		1.00	0.94	1.06
July	63.00	55.00	0.96	1.00	0.77	1.00		1.00	0.95	1.06
August	62.00	58.00	0.97	1.00	0.78	1.00		1.00	0.95	1.05
September	56.00	69.00	0.98	1.00	0.73	1.00		1.00	0.94	1.06
October	46.50	67.00	0.99	1.00	0.65	1.00		0.99	0.93	1.08
November	36.50	80.00	0.97	1.00	0.58	0.93		0.97	0.89	1.13
December	31.00	83.00	0.96	0.93	0.57	0.93		0.95	0.87	1.15
MEAN	45.96	66.67	0.97	0.97	0.66	0.97		0.98	0.91	1.10

COUNTRY: SWEDEN

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	MANB	MECA	MEAN	MULTIPLE
January	27.00	87.00	0.95	0.88	0.55	0.83		0.92	0.83	1.21
February	26.50	75.00	0.95	0.88	0.55	0.83		0.91	0.82	1.21
March	31.50	67.00	0.96	0.93	0.57	0.92		0.95	0.87	1.15
April	38.50	62.00	0.97	1.00	0.59	0.92		0.98	0.89	1.12
May	49.00	54.00	0.99	1.00	0.67	1.00		1.00	0.93	1.07
June	57.00	55.00	0.98	1.00	0.73	1.00		1.00	0.94	1.06
July	62.50	59.00	0.97	1.00	0.76	1.00		1.00	0.95	1.06
August	59.50	64.00	0.98	1.00	0.75	1.00		1.00	0.95	1.06
September	52.00	68.00	0.99	1.00	0.68	1.00		1.00	0.93	1.07
October	43.50	76.00	0.99	1.00	0.62	1.00		0.98	0.92	1.09
November	34.50	84.00	0.97	1.00	0.57	0.92		0.97	0.89	1.13
December	29.50	86.00	0.96	0.90	0.55	0.83		0.93	0.83	1.20
MEAN	43.58	69.75	0.97	0.97	0.63	0.94		0.97	0.90	1.13

COUNTRY: NORWAY

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	MANB	MECA	MEAN	MULTIPLE
January	25.00	83.00	0.95	0.83	0.53	0.83		0.93	0.81	1.23
February	24.00	75.00	0.94	0.83	0.53	0.83		0.93	0.81	1.23
March	32.50	65.00	0.97	0.86	0.56	0.92		0.97	0.86	1.16
April	42.00	56.00	0.98	0.95	0.60	1.00		0.99	0.90	1.11
May	52.50	51.00	0.99	1.00	0.69	1.00		1.00	0.94	1.07
June	60.00	54.00	0.97	1.00	0.74	1.00		1.00	0.94	1.06
July	64.50	57.00	0.94	1.00	0.78	1.00		1.00	0.95	1.05
August	61.00	61.00	0.97	1.00	0.75	1.00		1.00	0.94	1.06
September	52.50	65.00	0.98	1.00	0.69	1.00		1.00	0.93	1.07
October	43.00	72.00	0.98	1.00	0.62	1.00		0.99	0.92	1.09
November	33.00	82.00	0.97	0.93	0.57	0.92		0.96	0.87	1.15
December	27.50	85.00	0.95	0.88	0.54	0.83		0.92	0.82	1.21
MEAN	43.13	67.17	0.97	0.94	0.63	0.94		0.97	0.89	1.13

COUNTRY: DENMARK

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	31.00	86.00	0.96	0.93	0.56	0.92		0.93	0.86	1.16
February	31.50	81.00	0.96	0.93	0.56	0.92		0.96	0.87	1.15
March	34.50	74.00	0.97	0.96	0.58	0.92		0.98	0.88	1.13
April	44.00	65.00	0.98	1.00	0.62	1.00		0.99	0.92	1.09
May	51.50	59.00	0.99	1.00	0.69	1.00		1.00	0.94	1.07
June	58.50	63.00	0.98	1.00	0.75	1.00		1.00	0.95	1.06
July	62.00	66.00	0.97	1.00	0.75	1.00		0.99	0.94	1.06
August	61.50	68.00	0.97	1.00	0.74	1.00		0.99	0.94	1.06
September	56.00	73.00	0.98	1.00	0.69	1.00		1.00	0.93	1.07
October	47.50	78.00	0.99	1.00	0.64	1.00		0.99	0.92	1.08
November	41.00	86.00	0.98	1.00	0.59	1.00		0.96	0.91	1.10
December	35.50	89.00	0.97	1.00	0.57	0.92		0.94	0.88	1.14
MEAN	46.21	74.00	0.98	0.99	0.65	0.97		0.98	0.91	1.10

COUNTRY: SPAIN

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	48.00	68.00	0.99		0.67			1.00	0.89	1.13
February	50.50	59.00	1.00		0.68			1.00	0.89	1.12
March	54.00	61.00	0.98		0.68			1.00	0.89	1.13
April	57.50	61.00	0.98		0.72			1.00	0.90	1.11
May	64.00	61.00	0.96		0.80			1.00	0.92	1.09
June	70.00	61.00	0.95		0.90		0.75	1.00	0.90	1.11
July	75.00	61.00	0.92		0.98		0.75	0.99	0.91	1.10
August	75.50	63.00	0.91		0.99		0.75	0.99	0.91	1.10
September	71.50	64.00	0.94		0.91		0.75	0.99	0.90	1.11
October	64.50	66.00	0.96		0.79			1.00	0.92	1.09
November	56.00	63.00	0.98		0.73			1.00	0.90	1.11
December	50.50	68.00	1.00		0.69			1.00	0.90	1.12
MEAN	61.42	61.67	0.96		0.80		0.75	1.00	0.90	1.11

COUNTRY: PORTUGAL

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	54.00	72.00	0.98		0.70		1.00	1.00	0.92	1.09
February	54.00	69.00	0.98		0.70		1.00	1.00	0.92	1.09
March	56.50	68.00	0.98		0.71		1.00	1.00	0.92	1.08
April	59.50	62.00	0.97		0.74		1.00	1.00	0.93	1.07
May	64.50	59.00	0.96		0.80		1.00	1.00	0.94	1.06
June	68.50	55.00	0.96		0.84		0.75	1.00	0.89	1.13
July	73.50	52.00	0.94		0.90		0.75	0.99	0.90	1.12
August	74.50	52.00	0.93		0.92		0.75	0.99	0.90	1.11
September	71.00	59.00	0.95		0.91		0.75	0.99	0.90	1.11
October	65.50	65.00	0.94		0.81		1.00	1.00	0.94	1.06
November	59.00	71.00	0.98		0.74		1.00	1.00	0.93	1.08
December	55.00	71.00	0.99		0.71		1.00	1.00	0.93	1.08
MEAN	62.96	62.92	0.97		0.79		0.92	1.00	0.92	1.09

COUNTRY: FRANCE

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAMB	NECA	MEAN	MULTIPLE
January	37.00	77.00	0.98	0.93	0.56	0.92		0.97	0.88	1.10
February	39.00	69.00	0.98	0.93	0.59	0.92		0.98	0.88	1.11
March	44.00	59.00	0.98	0.96	0.63	1.00		1.00	0.91	1.09
April	50.50	50.00	1.00	1.00	0.67	1.00		1.00	0.93	1.07
May	57.00	53.00	0.98	1.00	0.72	1.00		1.00	0.94	1.06
June	63.50	55.00	0.96	1.00	0.76	1.00		1.00	0.94	1.06
July	66.50	55.00	0.96	1.00	0.78	1.00		1.00	0.95	1.05
August	65.00	56.00	0.96	1.00	0.77	1.00		1.00	0.95	1.05
September	59.50	59.00	0.98	1.00	0.80	1.00		1.00	0.96	1.05
October	51.50	68.00	0.99	1.00	0.68	1.00		1.00	0.93	1.07
November	43.50	76.00	0.98	1.00	0.62	1.00		0.99	0.91	1.09
December	38.00	80.00	0.97	1.00	0.59	0.92		0.98	0.89	1.12
MEAN	51.00	63.83	0.98	0.99	0.69	0.98		0.99	0.92	1.08

COUNTRY: ITALY

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAMB	NECA	MEAN	MULTIPLE
January	46.50	68.00	0.99	0.93	0.64	1.00		0.99	0.91	1.10
February	47.50	64.00	0.99	0.93	0.65	1.00		1.00	0.91	1.09
March	52.00	56.00	0.99	0.96	0.69	1.00		1.00	0.93	1.08
April	55.00	54.00	0.98	1.00	0.72	1.00		1.00	0.94	1.06
May	64.50	54.00	0.96	1.00	0.79	1.00		1.00	0.95	1.05
June	71.00	48.00	0.94	1.00	0.83	1.00		0.99	0.95	1.05
July	74.00	42.00	0.90	1.00	0.79	1.00		0.99	0.94	1.07
August	74.00	43.00	0.90	1.00	0.83	1.00		0.99	0.94	1.06
September	72.00	50.00	0.90	1.00	0.85	1.00		0.99	0.96	1.05
October	63.00	59.00	0.96	1.00	0.78	1.00		1.00	0.95	1.05
November	54.50	66.00	0.98	1.00	0.69	1.00		1.00	0.93	1.07
December	48.50	78.00	0.99	1.00	0.67	1.00		0.99	0.93	1.08
MEAN	60.54	56.17	0.96	0.99	0.74	1.00		1.00	0.94	1.07

COUNTRY: SWITZERLAND

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAMB	NECA	MEAN	MULTIPLE
January	34.00	78.00	0.97	0.93	0.57	0.92		0.96	0.87	1.15
February	34.50	71.00	0.98	0.93	0.58	0.92		0.98	0.88	1.14
March	43.00	61.00	0.98	0.96	0.62	1.00		1.00	0.91	1.10
April	49.50	55.00	1.00	1.00	0.67	1.00		1.00	0.93	1.07
May	64.00	57.00	0.96	1.00	0.79	1.00		1.00	0.95	1.05
June	67.50	55.00	0.96	1.00	0.82	1.00		1.00	0.96	1.05
July	67.50	55.00	0.96	1.00	0.81	1.00		1.00	0.95	1.05
August	64.50	57.00	0.96	1.00	0.81	1.00		1.00	0.95	1.05
September	60.50	63.00	0.97	1.00	0.76	1.00		1.00	0.95	1.06
October	51.00	69.00	0.99	1.00	0.68	1.00		1.00	0.93	1.07
November	42.00	76.00	0.98	1.00	0.61	1.00		0.98	0.91	1.09
December	38.50	78.00	0.97	1.00	0.57	0.92		0.97	0.89	1.13
MEAN	51.46	64.58	0.97	0.99	0.69	0.98		0.99	0.92	1.08

COUNTRY: AUSTRIA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	30.00	74.00	0.96	0.93	0.56	0.92		0.97	0.87	1.79
February	33.00	68.00	0.97	0.93	0.58	0.92		0.98	0.88	1.72
March	40.50	57.00	0.98	0.96	0.61	1.00		1.00	0.91	1.64
April	49.00	51.00	1.00	1.00	0.72	1.00		1.00	0.94	1.39
May	58.00	53.00	0.98	1.00	0.75	1.00		1.00	0.95	1.33
June	63.50	54.00	0.97	1.00	0.78	1.00		1.00	0.95	1.28
July	67.00	54.00	0.96	1.00	0.81	1.00		1.00	0.95	1.23
August	65.50	55.00	0.97	1.00	0.81	1.00		1.00	0.96	1.23
September	59.00	52.00	0.97	1.00	0.75	1.00		1.00	0.94	1.33
October	49.50	67.00	1.00	1.00	0.68	1.00		0.99	0.93	1.47
November	40.00	75.00	0.98	1.00	0.61	1.00		0.99	0.92	1.64
December	33.50	78.00	0.97	1.00	0.56	0.92		0.96	0.88	1.79
MEAN	49.04	61.50	0.98	0.99	0.69	0.98		0.99	0.92	1.49

COUNTRY: TURKEY

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	48.50	74.00	0.98		0.61	1.00		0.99	0.90	1.12
February	42.00	71.00	0.98		0.61	1.00		0.99	0.90	1.12
March	46.50	65.00	0.99		0.65	1.00		0.99	0.91	1.10
April	53.00	62.00	0.98		0.70	1.00		1.00	0.92	1.09
May	60.50	62.00	0.97		0.76	1.00		1.00	0.93	1.07
June	68.50	57.00	0.96		0.80	1.00		1.00	0.94	1.06
July	73.00	55.00	0.94		0.91	1.00		0.99	0.94	1.04
August	73.50	55.00	0.94		0.91	1.00		1.00	0.96	1.04
September	68.00	59.00	0.96		0.86	1.00		1.00	0.95	1.05
October	60.50	64.00	0.97		0.76	1.00		1.00	0.93	1.08
November	53.50	71.00	0.98		0.67	1.00		1.00	0.91	1.10
December	46.00	74.00	0.99		0.62	1.00		0.99	0.90	1.11
MEAN	57.13	64.08	0.97		0.74	1.00		1.00	0.93	1.08

COUNTRY: GREECE

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	48.00	62.00	0.99		0.68			1.00	0.89	1.12
February	49.00	61.00	1.00		0.68			1.00	0.89	1.12
March	53.00	54.00	0.98		0.73			1.00	0.90	1.11
April	59.50	47.00	0.98		0.73			1.00	0.90	1.11
May	68.50	44.00	0.96		0.79			1.00	0.92	1.09
June	76.00	40.00	0.85		0.79			0.99	0.88	1.14
July	81.00	32.00	0.80		0.72		0.79	0.98	0.82	1.22
August	81.00	33.00	0.80		0.72		0.79	0.98	0.82	1.22
September	74.50	38.00	0.82		0.78			0.99	0.86	1.16
October	67.00	53.00	0.96		0.88			1.00	0.92	1.09
November	58.00	60.00	0.98		0.75			1.00	0.91	1.10
December	51.50	63.00	0.99		0.68			1.00	0.89	1.12
MEAN	63.92	48.83	0.93		0.74		0.79	1.00	0.88	1.13

COUNTRY: SAUDI ARABIA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAMB	NECA	MEAN	MULTIPLE
January	58.00	44.00	0.98		0.71			1.00	0.90	1.13
February	60.50	37.00	0.97		0.71		0.79	1.00	0.87	1.15
March	69.00	34.00	0.96		0.75		0.79	1.00	0.88	1.14
April	76.50	34.00	0.84		0.75		0.79	0.99	0.84	1.19
May	86.00	31.00	0.70		0.68		0.79	0.96	0.78	1.28
June	92.00	31.00	0.58		0.63		0.79	0.92	0.71	1.41
July	93.50	19.00	0.58		0.57		0.79	0.91	0.69	1.44
August	91.00	19.00	0.58		0.57		0.79	0.91	0.69	1.44
September	87.00	24.00	0.76		0.62		0.79	0.94	0.76	1.31
October	77.50	25.00	0.83		0.67		0.79	0.99	0.82	1.22
November	69.50	33.00	0.95		0.73		0.79	1.00	0.87	1.15
December	59.50	52.00	0.97		0.73			1.00	0.90	1.11
MEAN	76.58	32.08	0.78		0.68		0.79	0.97	0.81	1.25

COUNTRY: KUWAIT

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAMB	NECA	MEAN	MULTIPLE
January	55.00	61.00	0.98		0.73			1.00	0.90	1.11
February	58.00	61.00	0.98		0.73			1.00	0.90	1.11
March	65.50	61.00	0.96		0.81		0.75	1.00	0.88	1.14
April	75.50	55.00	0.85		0.93		0.75	0.99	0.88	1.14
May	85.50	55.00	0.73		0.75		0.75	0.96	0.80	1.26
June	90.00	49.00	0.58		0.69		0.75	0.94	0.72	1.39
July	94.50	41.00	0.58		0.65		0.75	0.90	0.70	1.43
August	95.00	46.00	0.58		0.66		0.75	0.88	0.69	1.44
September	90.50	51.00	0.58		0.67		0.75	0.93	0.71	1.40
October	83.00	60.00	0.75		0.85		0.75	0.97	0.83	1.20
November	69.50	59.00	0.96		0.86		0.75	1.00	0.89	1.13
December	59.00	65.00	0.98		0.74			1.00	0.91	1.10
MEAN	76.67	55.33	0.77		0.75		0.75	0.96	0.82	1.24

COUNTRY: ISRAEL

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAMB	NECA	MEAN	MULTIPLE
January	57.00	56.00	0.98		0.72			1.00	0.90	1.11
February	58.50	56.00	0.98		0.74			1.00	0.91	1.10
March	62.00	56.00	0.97		0.76			1.00	0.91	1.10
April	67.50	57.00	0.96		0.82		0.75	1.00	0.88	1.13
May	74.00	59.00	0.88		0.96		0.75	0.99	0.90	1.12
June	78.00	66.00	0.76		0.94		0.75	0.98	0.87	1.15
July	81.50	68.00	0.76		0.90		0.75	0.96	0.84	1.19
August	83.00	69.00	0.75		0.88		0.75	0.95	0.81	1.23
September	81.00	66.00	0.76		0.90		0.75	0.96	0.84	1.19
October	76.50	66.00	0.83		0.93		0.75	0.98	0.87	1.15
November	69.00	56.00	0.96		0.87		0.75	1.00	0.90	1.12
December	60.50	56.00	0.97		0.76			1.00	0.91	1.10
MEAN	70.71	60.92	0.88		0.84		0.75	0.99	0.88	1.14

COUNTRY. LEBANON

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	56.50	70.00	0.98		0.72			1.00	0.90	1.11
February	57.00	70.00	0.98		0.72			1.00	0.90	1.11
March	60.00	69.00	0.97		0.75			0.99	0.90	1.11
April	65.00	67.00	0.96		0.80			0.99	0.92	1.09
May	71.00	64.00	0.89		0.90		0.75	0.99	0.88	1.13
June	76.00	61.00	0.84		0.98		0.75	0.99	0.89	1.12
July	80.06	58.00	0.76		0.90		0.75	0.98	0.85	1.18
August	81.50	57.00	0.75		0.90		0.75	0.97	0.84	1.19
September	79.50	57.00	0.77		0.92		0.75	0.98	0.86	1.17
October	75.00	62.00	0.85		0.98		0.75	0.99	0.89	1.12
November	67.00	61.00	0.96		0.85			1.00	0.94	1.07
December	60.00	69.00	0.97		0.75			1.00	0.91	1.10
MEAN	69.04	63.75	0.89		0.85		0.75	0.99	0.89	1.13

COUNTRY: PAKISTAN

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	61.00	63.00	0.97		0.76			1.00	0.91	1.10
February	61.50	73.00	0.96		0.79			0.99	0.91	1.09
March	76.00	79.00	0.85		0.78		0.75	0.96	0.86	1.20
April	81.50	87.00	0.76		0.73		0.75	0.92	0.79	1.27
May	86.00	88.00	0.72		0.65		0.75	0.88	0.75	1.33
June	87.50	86.00	0.63		0.67		0.75	0.87	0.73	1.37
July	86.00	85.00	0.72		0.65		0.75	0.88	0.75	1.33
August	83.50	90.00	0.77		0.64		0.75	0.90	0.77	1.30
September	82.50	89.00	0.78		0.68		0.75	0.91	0.78	1.28
October	81.50	83.00	0.79		0.73		0.75	0.92	0.80	1.24
November	75.50	68.00	0.87		0.93		0.75	0.98	0.88	1.14
December	68.50	64.00	0.96		0.87		0.75	1.00	0.90	1.12
MEAN	77.58	79.75	0.82		0.74		0.75	0.93	0.82	1.23

COUNTRY: KOREA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	23.50	41.00	0.92	0.83	0.53	0.83		0.95	0.81	1.23
February	28.50	45.00	0.96	0.83	0.55	0.83		0.97	0.83	1.21
March	38.00	50.00	0.98	0.88	0.57	0.92		0.99	0.87	1.15
April	51.50	59.00	0.99	0.95	0.69	1.00		1.00	0.93	1.08
May	61.50	59.00	0.96	1.00	0.76	1.00		1.00	0.94	1.06
June	70.50	71.00	0.94	1.00	0.83	1.00	0.75	0.99	0.93	1.09
July	77.00	76.00	0.84	1.00	0.80	1.00	0.75	0.96	0.89	1.12
August	79.00	71.00	0.77	1.00	0.87	1.00	0.75	0.97	0.89	1.12
September	68.50	64.00	0.96	1.00	0.87	1.00	0.75	1.00	0.93	1.08
October	56.00	54.00	0.98	1.00	0.73	1.00		1.00	0.94	1.06
November	41.50	52.00	0.98	0.93	0.60	1.00		1.00	0.90	1.11
December	28.50	49.00	0.96	0.88	0.55	0.83		0.98	0.84	1.19
MEAN	52.00	57.50	0.94	0.94	0.70	0.95	0.75	0.98	0.89	1.12

COUNTRY: JAPAN

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	MANB	NECA	MEAN	MULTIPLE
January	38.50	48.00	0.98	0.93	0.89	0.93		0.99	0.88	1.13
February	39.50	48.00	0.98	0.93	0.89	0.93		0.99	0.88	1.13
March	45.00	53.00	0.99	0.96	0.64	1.00		1.00	0.93	1.09
April	42.50	59.00	0.97	1.00	0.77	1.00		1.00	0.95	1.05
May	62.50	62.00	0.97	1.00	0.77	1.00		1.00	0.95	1.05
June	69.50	68.00	0.95	1.00	0.82	1.00	0.75	0.99	0.92	1.09
July	73.50	69.00	0.89	1.00	0.89	1.00	0.75	0.98	0.92	1.09
August	79.00	66.00	0.77	1.00	0.92	1.00	0.75	0.97	0.90	1.11
September	73.50	68.00	0.94	1.00	0.85	1.00	0.75	0.98	0.92	1.09
October	63.00	64.00	0.97	1.00	0.77	1.00		1.00	0.95	1.05
November	51.50	58.00	0.99	1.00	0.69	1.00		1.00	0.94	1.07
December	42.50	51.00	0.98	1.00	0.61	1.00		1.00	0.92	1.09
MEAN	58.21	59.50	0.95	0.99	0.74	0.99	0.75	0.99	0.93	1.09

COUNTRY: COSTA RICA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	MANB	NECA	MEAN	MULTIPLE
January	66.50	63.00	0.96		0.81			1.00	0.92	1.08
February	67.00	57.00	0.96		0.83			1.00	0.93	1.08
March	69.00	55.00	0.95		0.87		0.75	1.00	0.89	1.12
April	70.50	60.00	0.94		0.90		0.75	0.99	0.90	1.12
May	71.00	70.00	0.93		0.82		0.75	0.99	0.87	1.15
June	69.50	74.00	0.95		0.78		0.75	0.99	0.87	1.15
July	69.50	74.00	0.95		0.78		0.75	0.99	0.87	1.15
August	69.50	73.00	0.95		0.78		0.75	0.99	0.87	1.15
September	70.00	74.00	0.95		0.78		0.75	0.98	0.87	1.14
October	68.50	78.00	0.96		0.76		0.75	0.99	0.87	1.14
November	68.50	71.00	0.96		0.81		0.75	0.99	0.88	1.14
December	66.50	67.00	0.97		0.75			0.99	0.90	1.11
MEAN	68.83	68.17	0.95		0.81		0.75	0.99	0.89	1.13

COUNTRY: EL SALVADOR

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	MANB	NECA	MEAN	MULTIPLE
January	75.00	65.00	0.88		0.84			0.99	0.90	1.11
February	76.00	63.00	0.85		0.88			0.99	0.88	1.14
March	78.00	66.00	0.88		0.85			0.99	0.88	1.14
April	79.00	58.00	0.77		0.91			0.99	0.89	1.12
May	79.00	60.00	0.77		0.91		0.75	0.98	0.85	1.17
June	76.50	66.00	0.85		0.93		0.75	0.98	0.88	1.14
July	77.00	61.00	0.84		0.98		0.75	0.99	0.89	1.12
August	77.50	62.00	0.83		0.98		0.75	0.99	0.89	1.13
September	76.50	69.00	0.85		0.92		0.75	0.98	0.88	1.14
October	76.00	66.00	0.85		0.94		0.75	0.98	0.88	1.14
November	71.00	56.00	0.90		0.89		0.75	0.99	0.88	1.13
December	75.00	50.00	0.88		0.91			0.99	0.93	1.08
MEAN	76.38	56.00	0.84		0.91		0.75	0.99	0.89	1.13

COUNTRY: GUATEMALA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	63.00	67.00	0.97		0.77			0.99	0.91	1.10
February	65.50	63.00	0.96		0.82			1.00	0.93	1.08
March	69.00	51.00	0.95		0.83			1.00	0.93	1.08
April	70.00	51.00	0.95		0.83			1.00	0.93	1.08
May	72.00	55.00	0.98		0.89		0.75	0.99	0.88	1.13
June	71.00	70.00	0.94		0.85		0.75	0.99	0.88	1.13
July	69.00	67.00	0.95		0.89		0.75	0.99	0.98	1.12
August	69.50	73.00	0.95		0.82		0.75	0.99	0.88	1.14
September	69.50	71.00	0.95		0.82		0.75	0.99	0.88	1.14
October	68.00	77.00	0.96		0.77		0.75	0.99	0.87	1.15
November	65.50	71.00	0.96		0.78			0.99	0.91	1.10
December	63.50	70.00	0.97		0.76			0.99	0.91	1.10
MEAN	67.96	65.33	0.95		0.82		0.75	0.99	0.90	1.11

COUNTRY: MEXICO

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	54.00	34.00	0.99		0.65		0.79	1.00	0.86	1.17
February	44.00	28.00	0.96		0.67		0.79	1.00	0.86	1.17
March	41.00	26.00	0.97		0.64		0.79	1.00	0.85	1.18
April	44.00	29.00	0.96		0.68		0.79	1.00	0.86	1.17
May	44.00	29.00	0.96		0.68		0.79	1.00	0.86	1.17
June	65.50	48.00	0.96		0.78			1.00	0.91	1.09
July	63.00	55.00	0.97		0.78			1.00	0.92	1.09
August	63.50	50.00	0.97		0.76			1.00	0.91	1.10
September	63.50	54.00	0.97		0.77			1.00	0.91	1.09
October	60.00	47.00	0.97		0.73			1.00	0.90	1.11
November	57.00	41.00	0.98		0.69			1.00	0.89	1.12
December	54.50	37.00	0.99		0.66			1.00	0.88	1.13
MEAN	61.50	39.83	0.97		0.71		0.79	1.00	0.88	1.13

COUNTRY: COLOMBIA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	57.50	51.00	0.98		0.73			1.00	0.90	1.11
February	58.50	53.00	0.98		0.74			1.00	0.91	1.10
March	58.50	52.00	0.98		0.74			1.00	0.91	1.10
April	59.00	57.00	0.98		0.75			1.00	0.91	1.10
May	58.50	58.00	0.98		0.75			1.00	0.91	1.10
June	58.00	56.00	0.98		0.75			1.00	0.91	1.10
July	57.00	56.00	0.99		0.73			1.00	0.91	1.10
August	57.50	54.00	0.98		0.72			1.00	0.90	1.11
September	57.50	54.00	0.98		0.72			1.00	0.90	1.11
October	58.00	61.00	0.98		0.74			1.00	0.91	1.10
November	58.00	64.00	0.98		0.74			1.00	0.91	1.10
December	57.50	56.00	0.98		0.73			1.00	0.90	1.11
MEAN	57.96	56.00	0.98		0.74			1.00	0.91	1.10

COUNTRY: ECUADOR

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CARRIER	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	59.00	54.00	0.98		0.75			1.00	0.91	1.10
February	59.00	59.00	0.98		0.67			1.00	0.88	1.13
March	59.00	59.00	0.98		0.67			1.00	0.88	1.13
April	58.50	60.00	0.98		0.74			1.00	0.91	1.10
May	58.50	60.00	0.98		0.74			1.00	0.91	1.10
June	58.00	51.00	0.99		0.74			1.00	0.91	1.10
July	58.00	49.00	0.99		0.71			1.00	0.90	1.11
August	54.00	49.00	0.99		0.67			1.00	0.89	1.13
September	54.00	44.00	0.99		0.68			1.00	0.89	1.12
October	54.00	53.00	0.99		0.71			1.00	0.90	1.11
November	53.50	53.00	0.99		0.64			1.00	0.88	1.14
December	54.00	54.00	0.99		0.67			1.00	0.89	1.13
MEAN	56.63	52.50	0.99		0.70			1.00	0.90	1.12

COUNTRY: PANAMA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CARRIER	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	79.50	88.00	0.77		0.70		0.75	0.93	0.79	1.27
February	80.00	85.00	0.76		0.72		0.75	0.93	0.79	1.27
March	81.00	81.00	0.75		0.74		0.75	0.93	0.80	1.25
April	82.00	81.00	0.74		0.74		0.75	0.93	0.80	1.26
May	80.50	87.00	0.76		0.72		0.75	0.92	0.79	1.27
June	80.00	90.00	0.76		0.69		0.75	0.93	0.78	1.28
July	80.50	90.00	0.76		0.69		0.75	0.92	0.78	1.28
August	80.00	90.00	0.76		0.69		0.75	0.93	0.78	1.28
September	79.00	91.00	0.77		0.69		0.75	0.93	0.79	1.27
October	79.00	90.00	0.77		0.69		0.75	0.93	0.79	1.27
November	79.00	91.00	0.77		0.68		0.75	0.93	0.78	1.28
December	80.00	90.00	0.76		0.69		0.75	0.93	0.78	1.28
MEAN	80.04	87.83	0.76		0.70		0.75	0.93	0.79	1.27

COUNTRY: VENEZUELA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CARRIER	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	81.50	61.00	0.75		0.81		0.75	0.97	0.83	1.20
February	81.50	61.00	0.75		0.81		0.75	0.97	0.83	1.20
March	82.50	61.00	0.73		0.84		0.75	0.97	0.82	1.22
April	84.00	61.00	0.73		0.75		0.75	0.97	0.80	1.25
May	84.50	63.00	0.72		0.75		0.75	0.96	0.80	1.26
June	85.00	60.00	0.72		0.72		0.75	0.96	0.79	1.27
July	85.00	62.00	0.72		0.72		0.75	0.96	0.79	1.27
August	85.50	62.00	0.71		0.72		0.75	0.96	0.79	1.27
September	85.50	62.00	0.71		0.72		0.75	0.96	0.79	1.27
October	84.00	62.00	0.73		0.73		0.75	0.96	0.80	1.25
November	83.50	63.00	0.74		0.74		0.75	0.96	0.80	1.25
December	83.00	62.00	0.74		0.75		0.75	0.97	0.80	1.25
MEAN	83.79	61.67	0.73		0.77		0.75	0.96	0.80	1.25

COUNTRY: BRAZIL

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	78.50	70.00	0.78		0.91		0.75	0.97	0.85	1.17
February	79.00	71.00	0.77		0.90		0.75	0.97	0.85	1.18
March	77.50	74.00	0.83		0.84		0.75	0.97	0.85	1.18
April	76.50	73.00	0.85		0.85		0.75	0.98	0.86	1.17
May	71.50	70.00	0.90		0.82		0.75	0.98	0.86	1.16
June	70.00	69.00	0.95		0.83		0.75	0.99	0.88	1.14
July	69.00	68.00	0.95		0.82		0.75	0.99	0.88	1.14
August	70.00	66.00	0.95		0.87		0.75	0.99	0.89	1.12
September	70.00	72.00	0.95		0.82		0.75	0.99	0.88	1.14
October	71.50	73.00	0.90		0.82		0.75	0.98	0.86	1.16
November	73.50	72.00	0.88		0.85		0.75	0.98	0.87	1.16
December	76.50	73.00	0.85		0.89		0.75	0.97	0.87	1.16
MEAN	73.46	70.75	0.88		0.85		0.75	0.98	0.87	1.16

COUNTRY: BOLIVIA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	75.50	63.00	0.87		0.96		0.75	0.99	0.89	1.12
February	76.00	74.00	0.85		0.82		0.75	0.98	0.85	1.18
March	75.00	71.00	0.84		0.89		0.75	0.98	0.87	1.16
April	69.00	65.00	0.95		0.87		0.75	0.99	0.89	1.12
May	71.00	61.00	0.90		0.92		0.75	0.99	0.89	1.12
June	68.00	61.00	0.96		0.88		0.75	1.00	0.90	1.11
July	67.50	55.00	0.96		0.82		1.00	1.00	0.95	1.06
August	71.50	67.00	0.90		0.81		1.00	0.99	0.93	1.08
September	70.50	69.00	0.80		0.92		1.00	0.99	0.93	1.08
October	75.00	58.00	0.84		0.98		0.75	0.99	0.89	1.12
November	77.00	61.00	0.85		1.00		0.75	0.99	0.90	1.11
December	75.50	69.00	0.84		0.91		0.75	0.99	0.87	1.15
MEAN	73.29	61.17	0.88		0.90		0.81	0.99	0.90	1.12

COUNTRY: CHILE

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	69.00	38.00	0.95		0.75			1.00	0.90	1.11
February	68.00	40.00	0.94		0.76			1.00	0.91	1.10
March	65.50	41.00	0.97		0.75			1.00	0.91	1.10
April	59.50	46.00	0.98		0.73			1.00	0.90	1.11
May	53.00	50.00	0.99		0.70			1.00	0.90	1.12
June	47.50	64.00	0.99		0.67			1.00	0.89	1.13
July	48.00	60.00	0.99		0.68			1.00	0.89	1.12
August	50.50	58.00	1.00		0.69			1.00	0.90	1.12
September	54.00	55.00	0.98		0.71			1.00	0.90	1.12
October	58.50	50.00	0.98		0.74			1.00	0.91	1.10
November	63.00	41.00	0.96		0.74			1.00	0.90	1.11
December	67.00	38.00	0.96		0.75			1.00	0.90	1.11
MEAN	58.63	49.00	0.98		0.73			1.00	0.90	1.11

COUNTRY: PARAGUAY

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	83.00	54.00	0.73		0.90		0.75	0.97	0.84	1.19
February	82.50	55.00	0.73		0.91		0.75	0.97	0.84	1.19
March	80.50	55.00	0.77		0.92		0.75	0.97	0.85	1.17
April	74.50	59.00	0.85		0.98		0.75	0.99	0.89	1.12
May	67.50	62.00	0.96		0.85		1.00	1.00	0.95	1.05
June	62.50	61.00	0.97		0.76		1.00	1.00	0.93	1.07
July	63.50	56.00	0.97		0.78		1.00	1.00	0.94	1.07
August	67.50	53.00	0.96		0.81		1.00	1.00	0.94	1.06
September	71.50	48.00	0.95		0.83		1.00	0.99	0.94	1.06
October	74.00	50.00	0.88		0.89		1.00	0.99	0.94	1.06
November	77.50	53.00	0.83		0.93		1.00	0.99	0.94	1.07
December	82.00	50.00	0.75		0.92		1.00	0.98	0.91	1.10
MEAN	73.88	54.83	0.84		0.87		0.93	0.99	0.91	1.10

COUNTRY: PERU

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	74.00	69.00	0.88		0.90		0.75	0.98	0.88	1.14
February	75.00	66.00	0.84		0.93		0.75	0.98	0.88	1.14
March	74.50	64.00	0.88		0.94		0.75	0.99	0.89	1.12
April	71.50	66.00	0.95		0.89		0.75	0.99	0.90	1.12
May	67.00	76.00	0.96		0.77		1.00	0.99	0.93	1.08
June	63.00	80.00	0.97		0.73		1.00	0.98	0.92	1.09
July	62.00	77.00	0.97		0.73		1.00	0.99	0.92	1.08
August	61.00	78.00	0.97		0.73		1.00	0.99	0.92	1.09
September	62.50	76.00	0.97		0.73		1.00	0.99	0.92	1.08
October	64.50	72.00	0.96		0.78		1.00	0.99	0.93	1.07
November	67.00	71.00	0.96		0.78		1.00	0.99	0.93	1.07
December	73.00	70.00	0.89		0.88		0.75	0.98	0.88	1.14
MEAN	67.92	72.00	0.93		0.82		0.90	0.99	0.91	1.10

COUNTRY: URUGUAY

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	72.50	53.00	0.90		0.86		1.00	0.99	0.94	1.07
February	71.50	55.00	0.91		0.90		0.75	0.99	0.89	1.13
March	68.50	57.00	0.95		0.86		0.75	1.00	0.89	1.12
April	63.00	61.00	0.97		0.77		1.00	1.00	0.94	1.07
May	56.00	66.00	0.98		0.72		1.00	1.00	0.93	1.08
June	51.00	69.00	1.00		0.69		1.00	1.00	0.92	1.08
July	50.50	69.00	1.00		0.68		1.00	1.00	0.92	1.09
August	51.00	67.00	1.00		0.68		1.00	1.00	0.92	1.09
September	54.50	65.00	0.98		0.70		1.00	1.00	0.92	1.09
October	58.50	62.00	0.98		0.75		1.00	1.00	0.93	1.07
November	64.00	56.00	0.96		0.80		1.00	1.00	0.94	1.06
December	69.00	52.00	0.94		0.82		1.00	1.00	0.94	1.06
MEAN	60.75	61.00	0.96		0.77		0.96	1.00	0.92	1.08

COUNTRY: DOMINICAN REPUBLIC

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	75.00	64.00	0.00		0.93		0.75	0.99	0.89	1.13
February	75.50	58.00	0.84		0.98		0.75	0.99	0.89	1.12
March	75.50	60.00	0.84		0.99		0.75	0.99	0.89	1.12
April	77.00	62.00	0.84		0.98		0.75	0.98	0.89	1.13
May	78.50	65.00	0.81		0.93		0.75	0.97	0.87	1.14
June	79.50	66.00	0.78		0.92		0.75	0.97	0.86	1.17
July	80.00	66.00	0.76		0.90		0.75	0.97	0.85	1.18
August	80.50	66.00	0.76		0.89		0.75	0.96	0.84	1.19
September	80.00	66.00	0.76		0.90		0.75	0.97	0.85	1.18
October	79.50	66.00	0.78		0.92		0.75	0.97	0.86	1.17
November	78.00	66.00	0.81		0.93		0.75	0.97	0.87	1.16
December	76.00	66.00	0.82		0.93		0.75	0.97	0.87	1.15
MEAN	77.92	64.25	0.81		0.93		0.75	0.98	0.87	1.15

COUNTRY: HAITI

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	77.50	44.00	0.83		0.85		1.00	0.99	0.92	1.09
February	78.00	44.00	0.78		0.84		1.00	0.99	0.91	1.10
March	79.00	45.00	0.77		0.89		1.00	0.99	0.91	1.10
April	80.00	49.00	0.76		0.92		1.00	0.99	0.92	1.09
May	81.00	54.00	0.75		0.91		1.00	0.98	0.91	1.10
June	82.50	58.00	0.74		0.92		1.00	0.98	0.91	1.10
July	84.00	43.00	0.73		0.85		1.00	0.97	0.89	1.13
August	83.00	49.00	0.74		0.91		1.00	0.98	0.91	1.10
September	82.00	54.00	0.75		0.91		1.00	0.98	0.91	1.10
October	81.00	55.00	0.75		0.91		0.75	0.98	0.85	1.18
November	79.50	54.00	0.77		0.93		1.00	0.99	0.92	1.08
December	78.00	48.00	0.83		0.92		1.00	0.99	0.94	1.07
MEAN	80.46	49.08	0.77		0.90		0.98	0.98	0.91	1.10

COUNTRY: JAMAICA

MONTH	AVERAGE TEMP.	AV. REL. HUMIDITY	CRREL	CHICAGO BR.&IRON	ASCE	ASCE	NAHB	NECA	MEAN	MULTIPLE
January	76.50	61.00	0.84		1.00		0.75	0.99	0.90	1.12
February	76.50	62.00	0.84		0.99		0.75	0.99	0.89	1.12
March	77.00	62.00	0.83		0.98		0.75	0.99	0.89	1.13
April	78.50	66.00	0.80		0.93		0.75	0.97	0.87	1.15
May	79.50	68.00	0.80		0.91		0.75	0.97	0.86	1.17
June	81.50	68.00	0.75		0.90		0.75	0.96	0.84	1.19
July	81.50	65.00	0.75		0.89		0.75	0.96	0.84	1.19
August	81.50	70.00	0.75		0.90		0.75	0.96	0.84	1.19
September	81.00	70.00	0.75		0.89		0.75	0.96	0.84	1.19
October	80.50	73.00	0.74		0.85		0.75	0.96	0.83	1.20
November	79.00	68.00	0.77		0.91		0.75	0.97	0.85	1.18
December	78.00	62.00	0.78		0.94		0.75	0.97	0.86	1.16
MEAN	79.25	66.25	0.79		0.93		0.75	0.97	0.86	1.17

CERL DISTRIBUTION

Chief of Engineers
ATTN: Tech Monitor
ATTN: DAEN-ASI-L (2)
ATTN: DAEN-CCP
ATTN: DAEN-CW
ATTN: DAEN-CWE
ATTN: DAEN-CWM-R
ATTN: DAEN-CWO
ATTN: DAEN-CWP
ATTN: DAEN-EC
ATTN: DAEN-ECC
ATTN: DAEN-ECE
ATTN: DAEN-ZCF
ATTN: DAEN-ECR
ATTN: DAEN-RD
ATTN: DAEN-RDC
ATTN: DAEN-RDM
ATTN: DAEN-RM
ATTN: DAEN-ZCZ
ATTN: DAEN-ZCE
ATTN: DAEN-ZCI
ATTN: DAEN-ZCM

FESA, ATTN: Library 22060
ATTN: DET III 79906

US Army Engineer Districts
ATTN: Library (41)

US Army Engineer Divisions
ATTN: Library (14)

US Army Europe
AEAEN-ODCS/Engr 09403
ISAE 09081
V Corps
ATTN: DEH (11)
VII Corps
ATTN: DEH (15)
21st Support Command
ATTN: DEH (12)
USA Berlin
ATTN: DEH (11)
USASETAF
ATTN: DEH (10)
Allied Command Europe (ACE)
ATTN: DEH (3)

8th USA, Korea (19)

ROK/US Combined Forces Command 96301
ATTN: EUSA-HHC-CFC/Engr

USA Japan (USARJ)
ATTN: AJEN-FE 96343
ATTN: DEH-Honshu 96343
ATTN: DEH-Okinawa 96331

Area Engineer, AEDC-Area Office
Arnold Air Force Station, TN 37389

416th Engineer Command 60623
ATTN: Facilities Engineer

US Military Academy 10966
ATTN: Facilities Engineer
ATTN: Dept of Geography & Computer Science
ATTN: DSCPER/MAEN-A

AMMRC, ATTN: DRXMR-WE 02172

USA ARRCOM 61299
ATTN: DRCIS-RI-I
ATTN: DRSAR-IS

DARCOM - Dir., Inst., & Svcs.
ATTN: DEH (23)

DLA ATTN: DLA-WI 22314

DNA ATTN: NADS 20305

FORSCOM
FORSCOM Engineer, ATTN: AFEN-DEH
ATTN: DEH (23)

HSC
ATTN: HSLO-F 78234
ATTN: Facilities Engineer
Fitzsimons AMC 80240
Walter Reed AMC 20012

INSCOM - Ch, Instl. Div.
ATTN: Facilities Engineer (3)

MDW
ATTN: DEH (3)

MTMC
ATTN: MTMC-SA 20315
ATTN: Facilities Engineer (3)

NARADCOM, ATTN: DRDNA-F 01760

TARCOM, Fac. Div. 48090

TRADOC
HQ, TRADOC, ATTN: ATEN-DEH
ATTN: DEH (19)

TSARCOM, ATTN: STSAS-F 63120

USACC
ATTN: Facilities Engineer (2)

WESTCOM
ATTN: DEH
Fort Shafter 96858
ATTN: APEN-IM

SHAPE 09055
ATTN: Survivability Section, CCB-OPS
Infrastructure Branch, LANDA

HQ USEUCOM 09128
ATTN: ECJ 4/7-LOE

Fort Belvoir, VA 22060 (7)
ATTN: Canadian Liaison Officer
ATTN: Water Resources Support Center
ATTN: Engr Studies Center
ATTN: Engr Topographic Lab
ATTN: ATZA-DTE-SU
ATTN: ATZA-DTE-EM
ATTN: R&D Command

CRREL, ATTN: Library 03755

WES, ATTN: Library 39180

HQ, XVIII Airborne Corps and
Ft. Bragg 28307
ATTN: AFZA-FE-EE

Chanute AFB, IL 61868
3345 CES/DE, Stop 27

Norton AFB CA 92409
ATTN: AFRCE-MX/DEE

Tyndall AFB, FL 32403
AFESC/Engineering & Service Lab

NAFAC
ATTN: RDT&E Liaison Office (6)
ATTN: Sr. Tech. FAC-03T 22332
ATTN: Asst. CDR R&D, FAC-03 22332

NCEL 93041
ATTN: Library (Code L08A)

Defense Technical Info. Center 22314
ATTN: DDA (12)

Engineering Societies Library
New York, NY 10017

National Guard Bureau 20310
Installation Division

US Government Printing Office 22304
Receiving Section/Depository Copies (2)

US Army Env. Hygiene Agency
ATTN: HSHB-E 21010

National Bureau of Standards 20760

AFCS climatic zone labor adjustment factors / by Roger L. Brauer ...(et al.) - Champaign, Ill : Construction Engineering Research Laboratory, 1984.
38 p. (Technical report ; P-165)

1. Army Facilities Components System. 2. Construction workers - productivity. 3. Construction industry - labor productivity. 4. Climatic zones. I. Brauer, Roger L. II. Brown, Gerald J. III. Koehn, Edward. IV. Brooks, Samuel T. V. Mahon, Thomas. VI. Series ; Technical report (Construction Engineering Research Laboratory) ; P-165.

END

FILMED

10-84

DTIC